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IN
INTERIOR ALASKA

Institute of Northern Forestry

ABSTRACT

The large aspen tortrix caused extensive defoliation in interior Alaska during 1966 and 1967. Studies showed its life history to be similar to that reported from Canada. Overwintering larvae became active in early May and completed their development by early July. Natural mortality is discussed with emphasis on the effect of larval starvation on survival and egg production.

INTRODUCTION

An infestation of the large aspen tortrix, *Choristoneura conflictana* (Wlkr.), was discovered near Ester, Alaska, in June of 1966. Aerial observation in July showed various degrees of defoliation within aspen type over an area of about 5,000 square miles. The major infestation was north of the Richardson and Alaskan Highways, from Minto Flats east to George Lake (fig. 1). Defoliation was "patchy" within this area, varying from complete to no noticeable defoliation. Number of infested stands and degree of defoliation increased within this same general area during 1967--the entire area of noticeable defoliation about doubled in size. In addition, the insect was reported from various areas south of Glennallen and west toward Anchorage.

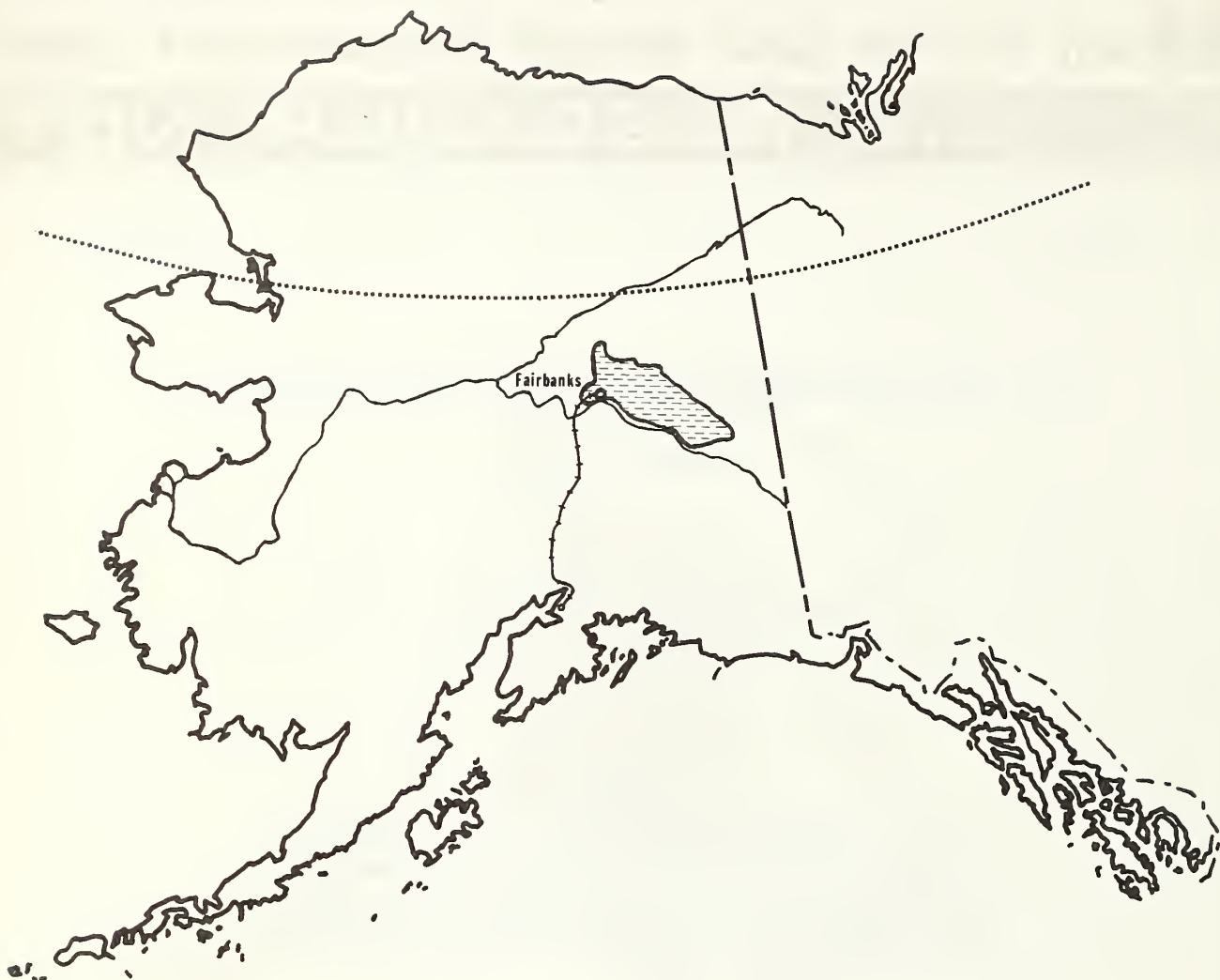


Figure 1.--Shaded portion shows area of heavy defoliation by *Choristoneura confluenta* in Alaska, 1966-67.

Adults reared from larvae during 1966 apparently represent the first record of this species from Alaska. Powell^{1/} places the northern distribution of this boreal species from New England across Canada to the Yukon Territory. It is likely that the species was present in Alaska in the past but was not collected. Radial growth data from 25-year-old aspen, birch, and spruce taken from the same site indicate the possibility of an insect defoliator on aspen during 1946-47. Lack of information on this species in interior Alaska prompted an investigation to determine its life history and habits.

MATERIALS AND METHODS

General observations were made of the large aspen tortrix following its discovery in 1966. Pupae were collected and kept in vials to record emergence, sex ratio, and parasitism. Two observation areas were established in the fall of 1966 in the vicinity of Fairbanks, Alaska. The Ester area is at an elevation of 750 feet; the Ester Dome area is at the 2,250-foot level. Weekly temperature records were kept throughout the year by the use of hygrothermographs. In addition, temperatures above and below snowline were taken weekly by use of thermistors attached to trees within the area.

Beginning in early May of 1967, branch samples were taken at weekly intervals from four trees within each observation area. The first 25 buds per branch and all growth from these buds were examined and all larvae counted and saved for future reference; this was similar to the sampling method used by Henson.^{2/} Complete destruction of the buds by the heavy larval population stopped the branch sampling.

Fifty larvae were collected at 2-day intervals and the head capsules measured by use of an ocular micrometer. The measurements were grouped into 0.02 mm. classes and plotted in the form of an accumulative histogram (fig. 2).

Pupae were collected from rolled leaves and placed in gel capsules for rearing. Emerging adults were sexed and disposed of at daily intervals; all parasites were saved. Egg masses were collected from each plot during the middle of the oviposition period. Additional collections were made in an area of light defoliation to make egg mass size

^{1/} Powell, J. A. Biological and taxonomic studies on tortricine moths, with reference to the species in California. Univ. Calif. Pub. Entomol., vol. 32, 317 pp. Berkeley and Los Angeles: Univ. Calif. Press. 1964.

^{2/} Henson, W. R. A sampling system for poplar insects. Can. J. Zool. 32:421-33. 1954.

comparisons. Egg masses were fixed in Kahle's fluid, transferred to a 70-percent ethanol solution, and later photographed to facilitate counting.

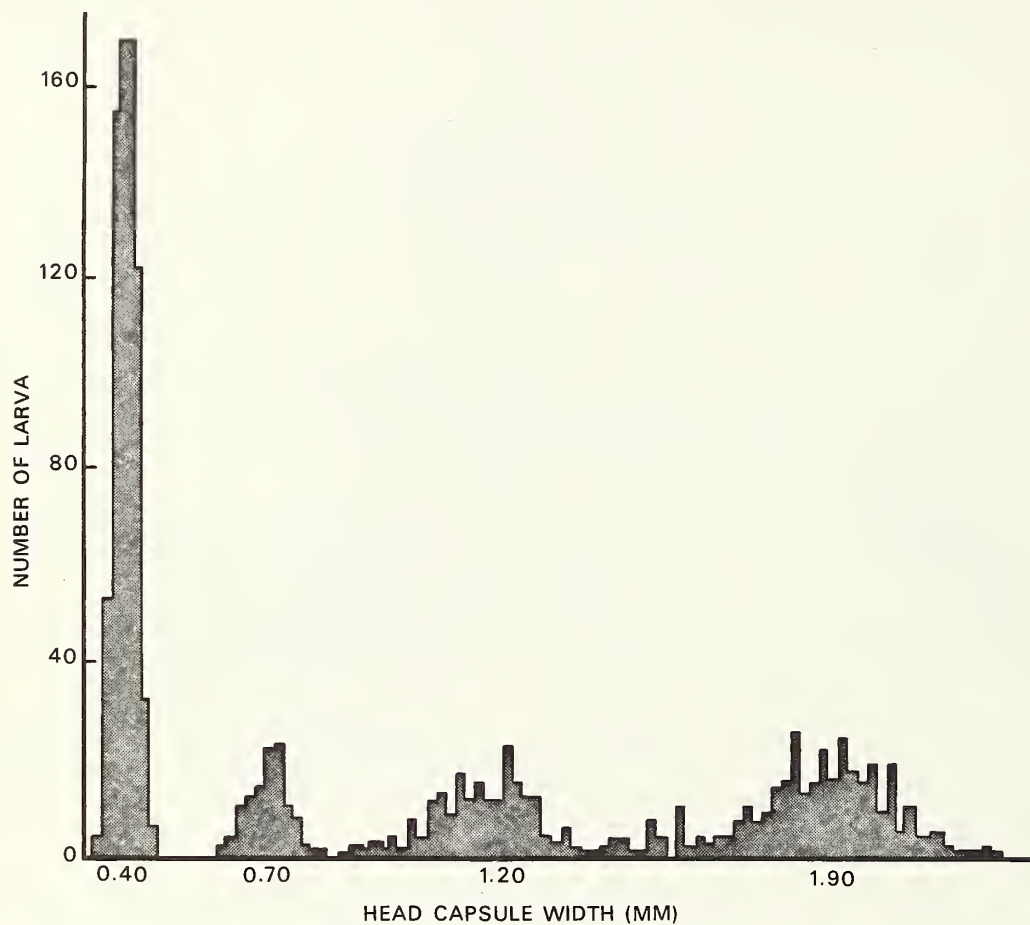


Figure 2.--Histogram of the head-capsule widths of *Choristoneura conflictana* larvae.
The first instar has been omitted.

LIFE HISTORY

The life history of the large aspen tortrix in Alaska's interior is similar to that reported in northern Manitoba and Saskatchewan, Canada, by Prentice.^{3/} The seasonal development (fig. 3) is slightly different due to local climatic patterns.

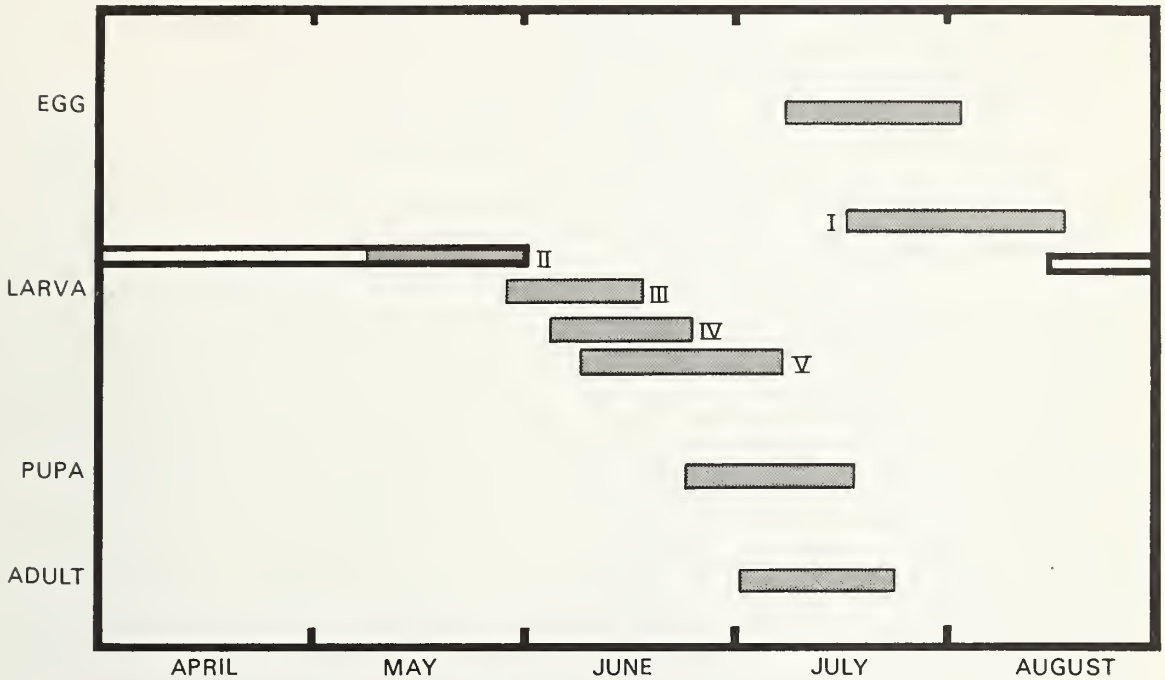


Figure 3.--Generalized seasonal development of *Choristoneura conflictana* in interior Alaska. The blank portion of the second instar represents the overwintering stage.

The insects overwinter as second-instar larvae within hibernacula spun in protected places. Overwintering sites may be found in moss and bark crevices at the base of trees, dead bark on twigs on the ground, and dead bark on twigs attached to trees. Qualitative observations during the spring of 1967 indicated that bark scales on twigs above the ground were favored as overwintering sites. These observations were

^{3/} Prentice, R. M. The life history and some aspects of the ecology of the large aspen tortrix, *Choristoneura conflictana* (Wlkr.) (N. Comb.) (Lepidoptera: Tortricidae). Can. Entomol. 87:461-473. 1955.

made during a period of population increase. Wickman^{4/} reported this same preference for hibernacula niches in California. This apparent choice of sites may be the result of population levels, stand characteristics, and/or the result of sampling methods.

There are five larval instars. The first instar is not shown in figure 2 because collecting did not start until the second instar was reached. Laboratory reared larvae underwent five instars; however, two individuals had six--probably a response to food or the microclimate inside the rearing containers.

The small larvae begin to migrate up the stems of aspen on warm days in early May. At this stage, they have yellowish bodies and black heads. In 1967, the first larvae were active on May 8 and May 17 at Ester and Ester Dome, respectively. Secondary hibernacula (fig. 4) were often constructed at the base of buds, possibly as a reaction to adverse temperatures. At this time of year, the temperatures during the day reached a maximum of 15° C. and the night temperatures went down to 0° C. or near it. The larvae mine into the buds and destroy the young tissue. Up to seven larvae per bud were found in the early stages of bud expansion. Complete defoliation may result before the buds have broken. The later stage larvae feed more openly; at this time, they are gray-green to black in body color with dark head capsules.



Figure 4.--Aspen buds with a secondary hibernaculum constructed between them. Two entrance holes covered by silk can be seen in the larger bud on the left.

^{4/} Wickman, B. E. The large aspen tortrix, *Choristoneura conflictana* in California (Lepidoptera: Tortricidae). J. Econ. Entomol. 56:494-496. 1963.

The pupae (fig. 5) are found within rolled leaves on the tree. Understory plants are often used as pupation sites in heavily defoliated stands. Adults are active from late June through early July.



Figure 5.--Pupa of *Choristoneura conflictana* that has been extracted from a rolled leaf.

The moths (fig. 6) are dull in color; the forewings are grayish with brownish markings. The females are fairly sluggish moths and appear to stay in the area of emergence. The sex ratio is approximately 1:1. The greenish egg masses are deposited primarily on the upper surface of the leaves; however, they can be found on the leaf undersides,



Figure 6.--Adult female of *Choristoneura conflictana*.

trunks, and on other vegetation. The number of eggs per mass in a nonstarved population ranged from 63 to 413. The eggs hatch by the last of July; first-instar larvae are active until mid-August. They feed gregariously within rolled leaves, skeletonizing the upper and lower surfaces. Leaves that had been rolled for pupation are a favorite feeding site for young larvae. The larvae migrate to protected areas, spin the hibernacula, molt to the second instar, and enter the overwintering stage.

NATURAL MORTALITY

Starvation was probably the most important mortality factor during 1967; this was not the case in 1966. Many areas were completely denuded before the buds had fully expanded. The lack of foliage caused the larvae to wander in search of acceptable food. Extensive webbing covered the grasses and herbaceous understory plants. Spruce trees were completely "tented over" by these webs, but not fed upon to any great extent. Many third- and fourth-instar larvae died, apparently from lack of acceptable food.

The number of eggs per mass was greatly reduced during 1967 as compared with 1966 at Ester and Ester Dome (table 1). Both study areas were completely defoliated 2 years in succession. The reduction of eggs per mass appears to be a direct result of larval starvation. In contrast, a nearby area (Chena) suffered heavy defoliation in 1967 only; the number of eggs per mass was comparable to the number produced in 1966 in the other two areas. Experiments are being conducted to determine the effect of food quantity and quality on fecundity.

Table 1.--Eggs per mass of *Choristoneura conflictana*
near Fairbanks, Alaska

Area	1966			1967		
	Number masses	Mean number eggs	Standard deviation	Number masses	Mean number eggs	Standard deviation
Ester	25	245.84	75.050	25	129.44	76.646
Ester Dome	100	224.28	62.717	25	124.00	56.365
Chena	--	--	--	25	241.32	97.942

Several parasites caused reduction in aspen tortrix populations in 1966 and 1967. The egg parasite, *Trichogramma minutum* Riley, attacked 90 percent of the egg masses; 1 to 33 percent of the eggs in each mass were parasitized (fig. 7). The tachinid, *Omotoma fumiferanae* (Toth.), destroyed between 34 and 61 percent of the population in 1966, based on four separate collections. General observations in 1967 indicated reduced effectiveness of this parasite. Only a few hymenopterous parasites were reared from pupae during 1966; *Phaeogenes* sp., probably *hariolus* (Cress.), was the most common.

In 1967, a large number of hymenopterous adults were reared from pupae collected in the two sample areas. Total parasitism by about six species was 22 percent at Ester and 5 percent at Ester Dome. The adults are being identified. The impact of the various species upon the host population has not been determined.

Low-temperature effects appeared to be minimal in the study areas. The overwintering survival of the 1966 population was excellent despite larvae being exposed to periods of below -25° C. which held for as much as 72 hours. The temperature was in the -40 's but not recorded due to ink flow failure during one period of about 3 days. Temperatures beneath the snow at the soil line were 10° to 25° C. warmer than air temperatures during periods of cold extremes. However, twig samples collected in February above snowline showed successful emergence of second-instar larvae.

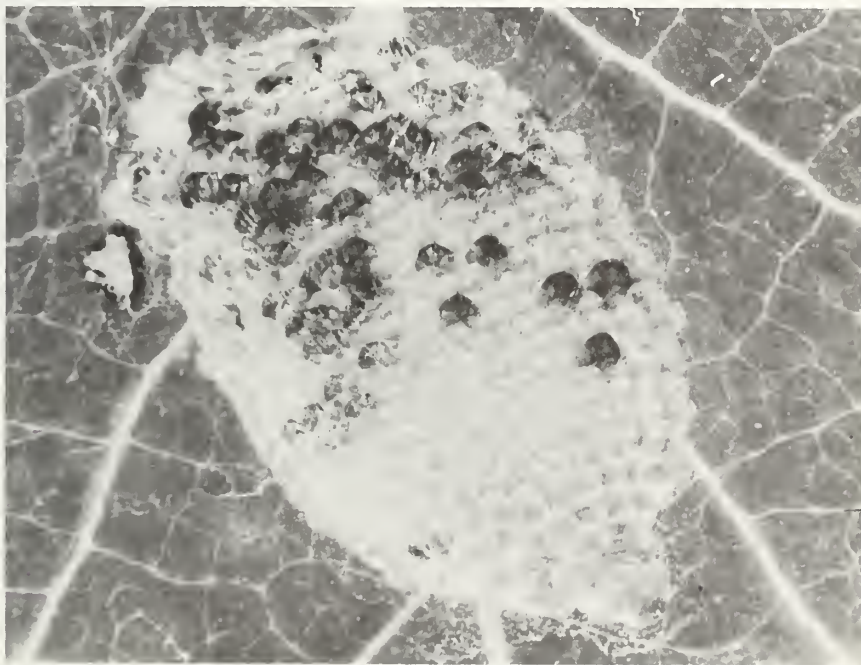


Figure 7.--Egg mass of *Choristoneura conflictana*. The black eggs are parasitized by *Trichogramma minutum* and the white "eggs" are empty chorions following eclosion.

DISCUSSION

The large aspen tortrix causes periodic outbreaks elsewhere in its range. Records of past infestations are not available for Alaska. It is probable that the insect has been present and is cyclic.

The factors responsible for population fluctuations in Alaska are not known. A number of parasites were reared; the effectiveness of these parasites was not determined. Starvation apparently is important in the rapid decline of large populations. In 1967, larvae in the areas observed were starving in the third and fourth instar. Heavy mortality occurred at this time. The reduction in number of eggs per mass appears to be the direct result of larval starvation. The scarcity of egg masses indicates low survival to the adult stage.

In interior Alaska, it appears that large aspen tortrix populations will probably collapse following 2 or 3 consecutive years of complete defoliation. Those stands severely defoliated for only one season will probably support a large population for another year.